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Surface Radiological Investigations at White Wing Scrap Yard

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Environmental Restoration Division
ORNL Environmental Restoration Program

Surface Radiological Investigations at White Wing Scrap Yard

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ABSTRACT

A surface radiological investigation of accessible areas at the White Wing Scrap Yard was conducted intermittently from December 1989 through June 1990 by the Measurement Applications and Development Group of the Health and Safety Research Division, Oak Ridge National Laboratory. The purposes of this survey were (1) to determine the presence, nature, and extent of surface radiological contamination and (2) to recommend interim corrective action to limit human exposures to radioactivity and minimize the potential for contaminant dispersion. The final results of the completed radiological survey, which will encompass the entire WAG 11 area, will be issued as an addendum ORNL/ER/INT report at a later date.

Surface measurements and visual observations identified a wide variety of radiological and physical hazards. Widespread clusters of small, localized radioactive hot spots were found throughout the accessible areas of the site. The most numerous and concentrated regions of contamination encompassing several grid blocks were found north of Hot Yard Road. Physical hazards include hundreds of sharp pieces of metal and broken glass on the ground surface, primarily north of Hot Yard Road.

The presence of uranium contamination in soil/rock samples and the isotopic composition of uranium (i.e., ^{235}U contributed ~15 atomic percent of uranium in sample B4) suggest that contaminated scrap material was stored by ORGDP and the Y-12 plant. Additional sampling, with subsequent radiological analysis and radiation measurements of surface debris, is necessary to fully characterize the site and accurately associate the waste types to responsible waste generators. Further investigations of a small subsidence in the ground surface revealed portions of several buried 0.2-m^3 (55-gal) metal drums. This finding suggests materials may have been disposed of by shallow-land burial.

These survey results show that current radiological conditions at the site remain an environmental problem and a potential risk to human health. Recommendations for corrective actions are included.

1. INTRODUCTION

A surface radiological investigation of accessible areas at the White Wing Scrap Yard was conducted intermittently from December 1989 through June 1990. This survey was performed by the Measurement Applications and Development Group of the Health and Safety Research Division (HASRD) of the Oak Ridge National Laboratory (ORNL) at the request of Environmental Restoration Program (ERP) personnel at ORNL. The purposes of this survey were (1) to determine the presence, nature, and extent of surface radiological contamination and (2) to recommend interim corrective action to limit human exposures to radioactivity and minimize the potential for contaminant dispersion. The final results of the completed radiological survey, which will encompass the entire WAG 11 area, will be issued as an addendum ORNL/ER/INT report at a later date.

White Wing Scrap Yard has been assigned to Waste Area Group (WAG) 11 and to Solid Waste Management Unit (SWMU) 11.1 by the ORNL ERP staff.[1] Figure 1.1 shows the location of WAG 11 in relation to the other 19 WAGs.

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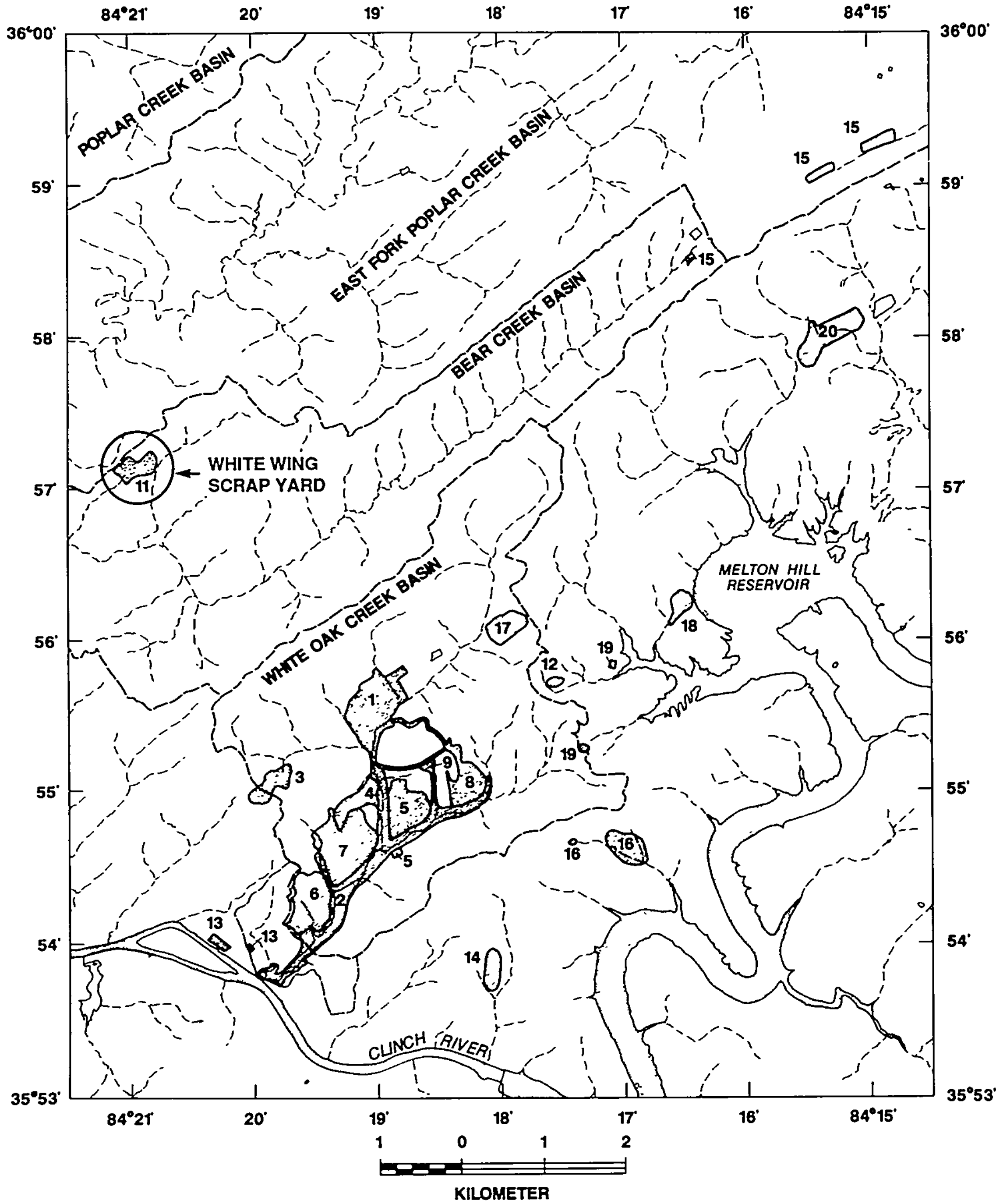

Fig. 1.1. Locations of the 20 Waste Area Groupings (WAGs). *Source:* W. J. Boegly, Jr., and G. K. Moore, *Environmental Data Package for the White Wing Scrap Yard (WAG 11),* Oak Ridge National Laboratory, ORNL/RAP-45 (April 1988).

2. SITE HISTORY

White Wing Scrap Yard is a largely wooded area, approximately 123,000 m^2 (30.4 acre), located in the McNew Hollow area on the western edge of East Fork Ridge.[2] It is 1.6 km (1 mile) east of the junction of White Wing Road (Highway 95) and Oak Ridge Turnpike[3] (Fig. 2.1) and is contained within administrative grid coordinates N34,500 to N35,800 and E27,500 to E29,300.

Approximately 100,000 of the 123,000 m^2 (25 of the 30.4 acres) were used for the aboveground storage of contaminated material from the Oak Ridge Gaseous Diffusion Plant (ORGDP), the Y-12 Plant, and ORNL. Reportedly, the area north of Hot Yard Road was used by ORGDP and Y-12, and the area south of the road was used by ORNL. No description exists for the materials stored by ORGDP or Y-12.[3] The approximately 14,000 m^3 (500,000 ft^3) of material stored by ORNL consisted of mild steel tanks 3 m (10 ft) in diameter and 12 m (40 ft) long; dump trucks; two pieces of earth-moving equipment [one weighing approximately 20,000 kg (22 tons)]; large glass-lined tanks; carcasses of walk-in hoods; small stainless steel and mild steel support frames; mild steel, stainless steel, and aluminum of many sizes and shapes;[4] and a reactor cell vessel (estimated contamination less than 25 g of ^{239}Pu).[5]

Material was first stored at the White Wing Scrap Yard in the early 1950s; however, the precise dates of material storage are uncertain, as is the time when the area was closed to further storage. During active use, the area north of Hot Yard Road was enclosed by a chain link fence and the area south of the road with a barbed wire fence. These fences were later removed during the site cleanup.[3] The approximate locations of the fenced areas, the WAG 11 boundary, and topographic features of the site are depicted in Fig. 2.2.

In 1966 efforts were begun to clean up the area in preparation for the proposed relocation of White Wing Road. Contaminated scrap materials were removed and buried in ORNL's Solid Waste Storage Area (SWSA) 5, and the uncontaminated material was sold to a contractor for scrap recovery. Site cleanup continued into October 1970, when the removal of about 4500 m^3 (6000 yd^3) of contaminated soil from the southern portion of the site was initiated. An aerial view taken prior to scrap removal (March 2, 1967) is shown in Fig. 2.3 and after preliminary cleanup activities (April 19, 1974) in Fig. 2.4.[3]

Prior to cleanup, the area south of Hot Yard Road was the most contaminated region at the scrap yard site. Five or more spots with dose rates up to 5 rad/h at 0.3 m (1 ft) above the surface were identified before cleanup. Some of these spots were ground into the soil by vehicles belonging to the scrap removal contractor. Other spots that could still be identified after cleanup required excavations to depths of up to 1.5 m (5 ft). The surface of the south storage area was scraped three times; large spots were excavated and the remaining smaller spots were removed by hand shovels until no contamination remained sufficient to give a Geiger-Mueller survey meter (GMSM) reading above 1 mrad/h at 0.3 m (1 ft) above the surface. Over 170 truckloads of contaminated earth

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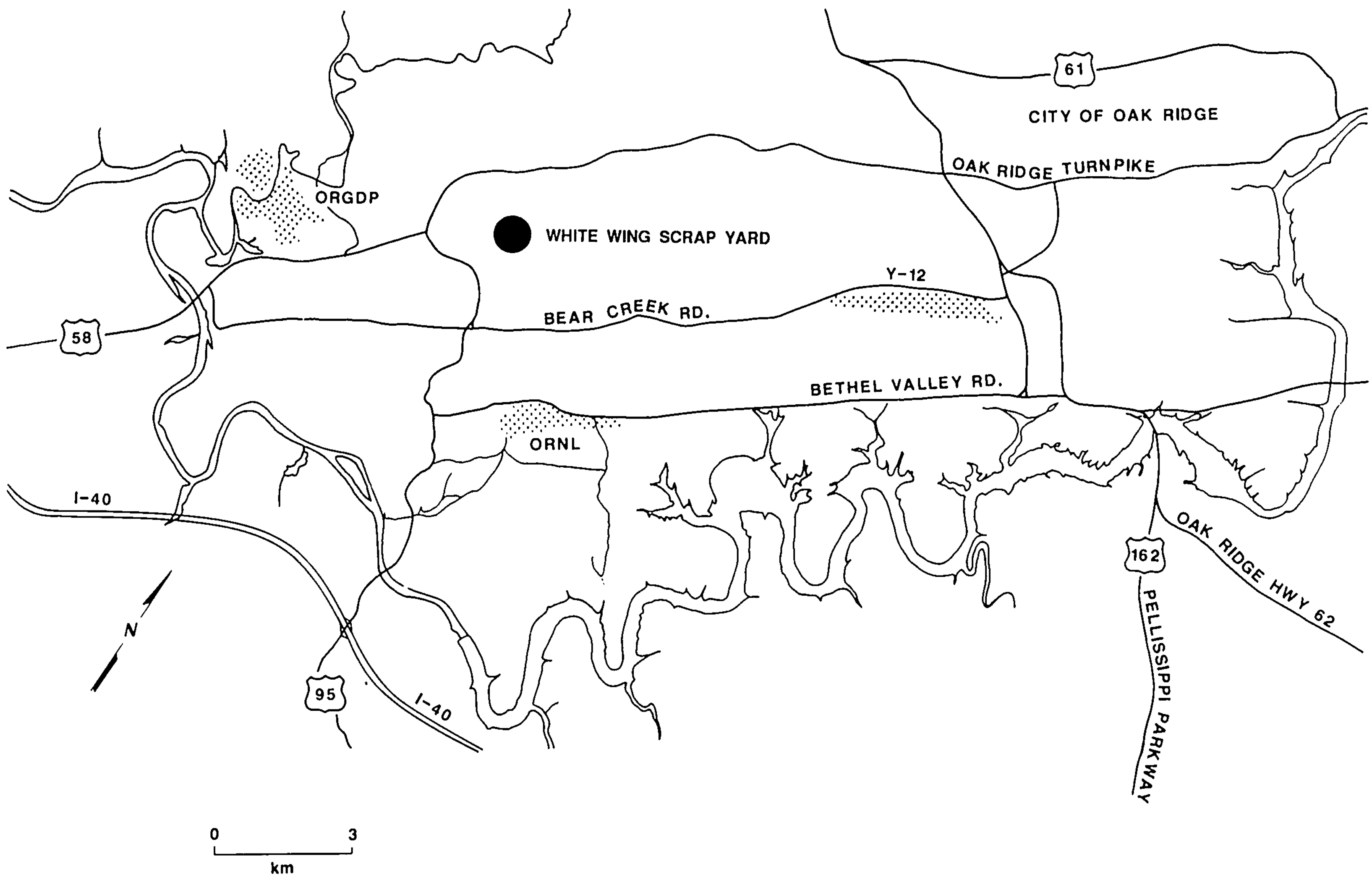

Fig. 2.1. Location of White Wing Scrap Yard (WAG 11).

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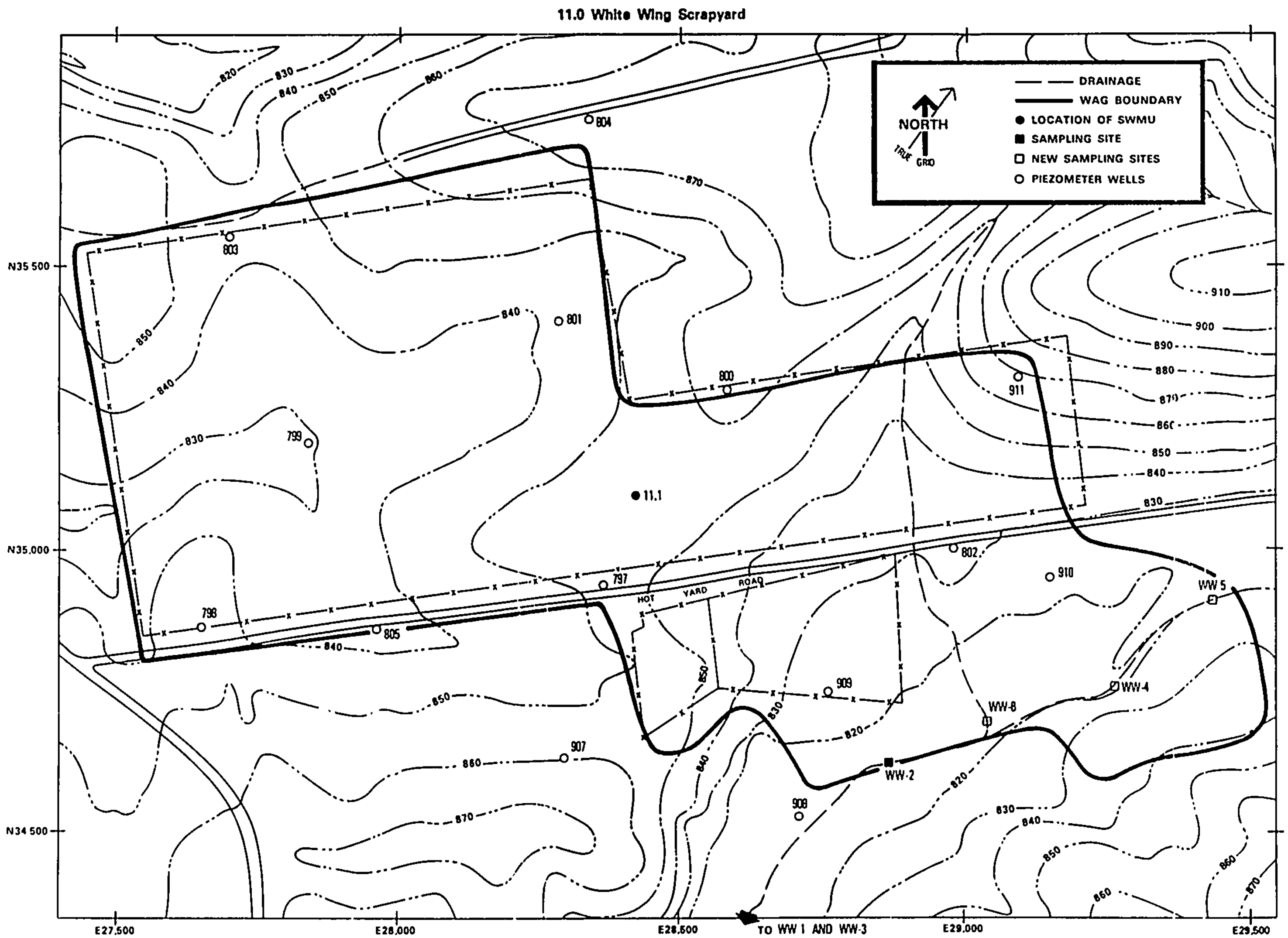

Fig. 2.2. Diagram of White Wing Scrap Yard (WAG 11). *Source:* W. J. Boegly, Jr., and G. K. Moore, *Environmental Data Package for the White Wing Scrap Yard (WAG 11),* Oak Ridge National Laboratory, ORNL/RAP-45 (April 1988).

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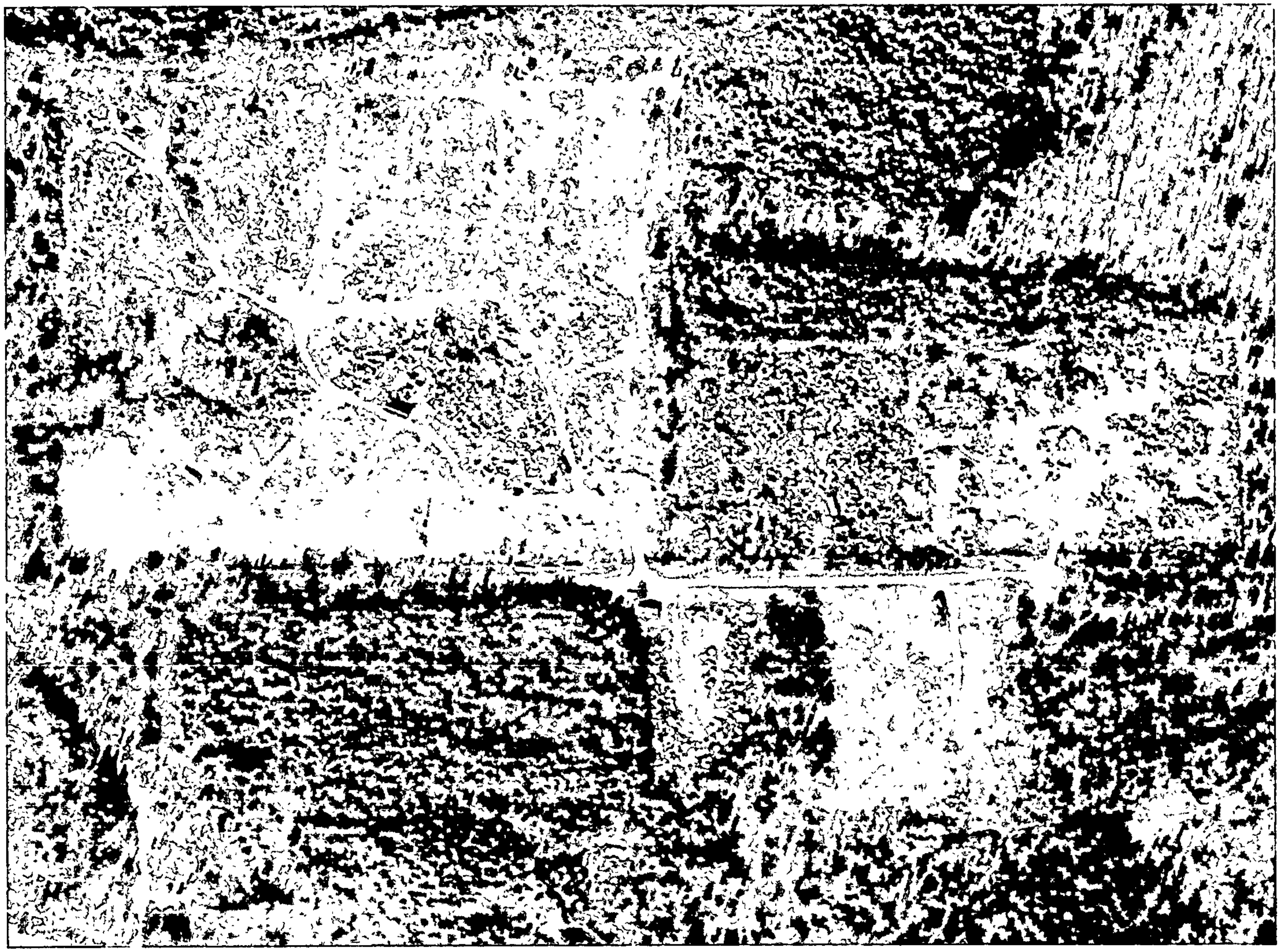

Fig. 2.3. Aerial view of White Wing Scrap Yard prior to surface cleanup (March 1967). *Source:* W. J. Boegly, Jr., and R. H. Ketelle, Oak Ridge National Laboratory.

K/PHOTO 90-0222

Fig. 2.4. Aerial view of White Wing Scrap Yard after surface cleanup (April 1974). *Source:* W. J. Boegly, Jr., and R. H. Ketelle, Oak Ridge National Laboratory.

were removed during these operations. There is a definite possibility that considerable contamination was covered; therefore, surface contamination surveys may not indicate subsurface conditions in the area south of Hot Yard Road. One sample collected in this area, presumably before cleanup, contained a gross gamma activity level of 9.2×10^8 cpm/g and gross alpha of 8.3×10^7 cpm/g. Radionuclide analyses showed 2.3 mCi/g of ^{137}Cs and 1.9 mCi/g of ^{90}Sr. Pulse height analyses showed the alpha emitters to be 85% 5.1 MeV (^{239}Pu or ^{240}Pu) and 15% 5.5 MeV (^{241}Am or ^{238}Pu).[6]

No decontamination activities other than scrap removal were conducted north of Hot Yard Road, but on June 5, 1971, the accessible area was inspected by a GMSM survey team. The survey paths were roughly linear from east to west with 1.5-m (5-ft) north-to-south spacing between paths. The detector elements were held approximately 0.3 m (1 ft) above the ground on all paths. Over 60 places measuring 1 mrad/h or greater at 0.3 m (1 ft) above the surface were marked with wooden stakes. Most of the readings ranged from 1 to 5 mrad/h with a maximum of approximately 15 mrad/h (50 mrad/h at ground level). Many other spots measuring 0.2 to 0.9 mrad/h at 0.3 m (1 ft) were also noted.[6] After the surface survey, the site was abandoned.[3]

On November 20, 1974, gamma exposure rates were measured over the scrap yard site during an aerial radiological survey conducted by EG&G. A photograph from that survey, depicting man-made gross-count-rate isopleths at 1 m (3.3 ft) above the ground surface, is shown in Fig. 2.5. The highest intensity isopleth included most of the northern area of the scrap yard, confirming that little or no decontamination activities had been conducted north of Hot Yard Road. The survey indicated that ^{137}Cs* and ^{234m}Pa were the dominant gamma sources present; analysis of the low-energy portion of the spectrum indicated that ^{234}Th and ^{235}U were probably also present in the scrap yard.[7]

In the fall of 1986, water, mud, and stream sediment from two locations adjacent to WAG 11 were collected in order to determine if hazardous materials and radionuclides had been released from the scrap metal yard. One site was a moist creek bed within the scrap yard, and the second site was located south of the yard where a stream draining the area passed under Highway 95. Stream gravels and dark mud were collected at both sites and water samples at one site. Among the extractable metals, only nickel was found in concentrations exceeding background levels in stream gravel samples. Concentrations of ^{90}Sr averaged 1 pCi/g in stream gravel at one site and were low but detectable (0.007 pCi/mL) in one water sample from the same site. Di-*n*-butylphthlate was the only organic detected in two black mud samples. Follow-up sampling was suggested to identify the source of the contamination.[8]

The follow-up sampling program, conducted in May 1987, included five sites: three within the WAG boundary, one site upstream, and one site downstream from the scrap yard. Cadmium, copper, and zinc were found at 5 to 8 times background levels at one site within the WAG boundary; cadmium exceeded background levels in all samples.

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*Barium-137*m*, a gamma emitter, is the short-lived decay product of the beta-emitter ^{137}Cs.

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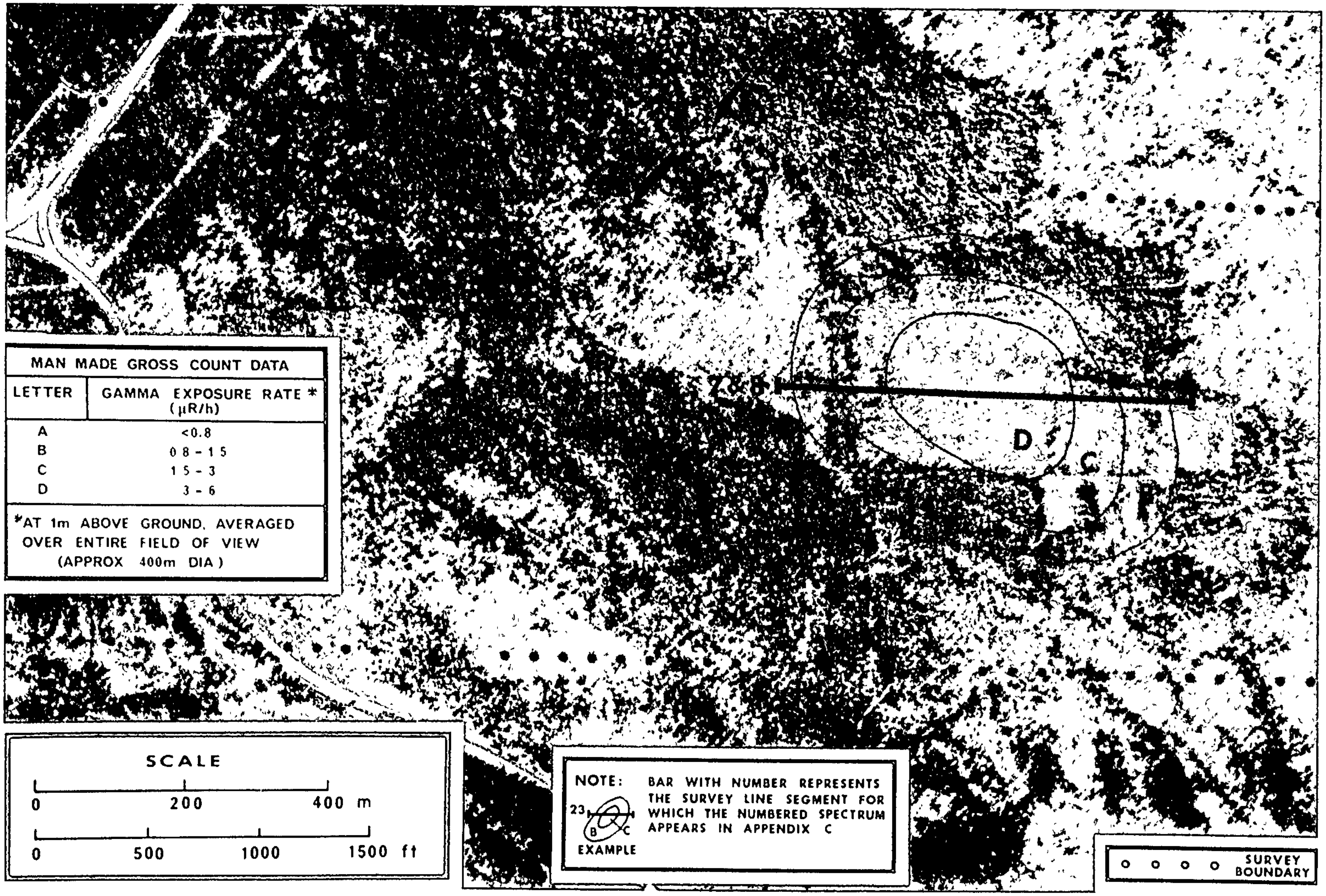

Fig. 2.5. Aerial view of White Wing Scrap Yard showing radiation isopleths (November 1974). *Source:* Z. G. Burson, *Aerial Radiological Surveys of ERDA's Oak Ridge Facilities and Vicinity (Survey Period: 1973-1974)*, EG&G, Inc., Las Vegas Area Operations, EGG-1183-1682 (February 1976).

Radionuclide concentrations in stream gravels were below background levels in most samples; however, inside the WAG boundary, ^{238}U was about 3.5 times background at one site and ^{90}Sr was 2 to 3 times background at two sites. The only organic detected in the sediment was di-*n*-butylphthalate, a component of plastic materials that is common in sediments.[3]

Groundwater samples, taken from selected piezometer wells in WAG 11 as part of the follow-up survey, showed chromium concentrations in the upgradient well above the National Interim Primary Drinking Water Standard (NIPDWS). Magnesium concentrations in downgradient wells ranged from 20 to 140 times the value observed in the upgradient well. Three volatile contaminants, methylene chloride, trichloroethylene, and acetone, were present at concentrations of 6 ppb, 184 ppb, and 23 ppb, respectively. Only methylene chloride was detected in more than one sample; trichloroethylene concentrations were significantly above the allowable limit of 5 ppb in drinking water.[3]

Based on the results from the 1986 and 1987 studies, it appears that WAG 11 is not a significant source of hazardous constituents although uncertainties remain concerning the presence of chromium, cadmium, organic contaminants, and surface radiation hot spots.[3]

Currently, parts of the area are overgrown with weeds, trees, and other types of vegetation. The amount of material remaining in the region is not known; however, small pieces of broken glass, scrap metal, and plastic appear on the surface over much of the site. On November 10, 1989, the scrap yard was roped and placarded with "Controlled Area" signs at 15-m (50-ft) intervals and Tennessee Wildlife Resources Agency (TWRA) safety zone signs at 30-m (100-ft) intervals in order to exclude deer hunters from the site. A planned FY 1990 Environmental Restoration Program activity includes installation of a three-strand barbed wire fence that will encircle the entire scrap yard. "Radiation Hazard—Keep Out" signs will be posted at specific intervals. Recent photographs of the site are shown in Figs. 2.6 through 2.9.

ORNL-PHOTO 395-90

Fig. 2.6. View of surface debris found north of Hot Yard Road at the White Wing Scrap Yard site (January 1990).

ORNL-PHOTO 402-90

Fig. 2.7. View looking west at large field where past aboveground storage of contaminated scrap occurred at the White Wing Scrap Yard site (January 1990). Reportedly this area was used by ORGDP.

ORNL-PHOTO 283-90

Fig. 2.8. View looking south at dirt road with scattered debris at the White Wing Scrap Yard site (January 1990). Reportedly this area was used by the Y-12 plant.

ORNL-PHOTO 388-90

Fig. 2.9. View looking southeast at location where past aboveground storage of contaminated scrap occurred at the White Wing Scrap Yard site (January 1990). Reportedly this area was used by ORNL.

3. SURVEY METHODS

A comprehensive description of the methods and instrumentation used in this survey is presented in *Procedures Manual for the ORNL Radiological Survey Activities (RASA) Program*.[9] All direct measurement results presented in this report are gross readings; background radiation levels have not been subtracted. Similarly, background concentrations have not been subtracted from radionuclide concentrations measured in environmental samples. Selected radioactively contaminated samples (i.e., soil, rocks, metal debris) were analyzed for uranium using isotope dilution/mass spectrometry. In addition, gamma spectrometry screening analysis was used to expeditiously identify dominant gamma-emitting radionuclides.

3.1 GAMMA RADIATION

Gamma radiation was measured with a sodium iodide (NaI) scintillation probe connected to a Victoreen Model 490 Thyac III ratemeter. Because NaI gamma scintillators are energy-dependent, measurements of gamma radiation levels made with these instruments must be normalized to pressurized ionization chamber (PIC) measurements to estimate gamma exposure rates. The function developed for these conversions is:

$$y = x/\mathrm{CF}$$

where

y = the exposure rate in μR/h,

x = the scintillometer measurements in counts per minute (cpm),

CF = the conversion factor determined in the field through a direct correlation between a selected number of PIC measurements and scintillometer measurements in cpm/(μR/h).

For this site, CF = 530 cpm/(μR/h).

When gamma radiation levels exceeded the limits of the NaI gamma scintillator (800,000 cpm), direct exposure measurements (mR/h) were made with an Eberline Ion Chamber, Model RO-2, and/or a Victoreen Model 450 BRF Ionization Chamber.

3.2 BETA-GAMMA RADIATION

Beta-gamma energy levels were detected with a portable Technical Associates (TA) miniscaler/ratemeter, Model PRS-3, with an HP-260 pancake detector (<2-mg/cm^2 wall thickness). A Bicron miniscaler/ratemeter with a Geiger-Mueller pancake detector was also used to detect beta-gamma radiation. After calibration of the detectors to a known uranium source, beta radiation detection levels in cpm were converted to dose rates in mrad/h using the following relationship:

$$2000 \text{ cpm} = 1 \text{ mrad/h} \qquad \text{or} \qquad (\text{mrad/h})/\text{cpm} = 0.0005 .$$

Several highly elevated beta-gamma radiation measurements were taken using a Victoreen Model 450 BRF Ionization Chamber.

3.3 ALPHA RADIATION

Alpha radiation was measured with an ORNL alpha survey meter, Model Q-2789-1, connected to a zinc sulfide scintillation probe. Counts per minute were recorded for a direct, 60-s measurement and converted to disintegrations per minute (dpm) per 100 cm^2 using the instrument-specific conversion factor. For most of the survey period, alpha and beta-gamma measurements were taken under wet conditions. Wet or moist conditions can somewhat attenuate the amount of detectable beta radiation and completely attenuate alpha radiation detection.

3.4 GRID

For convenience in reporting results, the White Wing Scrap Yard site was divided into 30-m (100-ft) grid blocks as shown in Fig. 3.1. The grid blocks are identified by the intersection of two perpendicular lines. The first coordinate identifies 100-ft distances from point 0 plus two digits representing additional number of feet (e.g., 1+00 = 100 ft or 9+35 = 935 ft). The second coordinate is derived from distance to the right or left of the base line (BL) (e.g., 100 ft to the right = 100R). An individual grid block is identified by the coordinates of its upper left corner (see Grid Block ID legend on Fig. 3.1). The survey grid coordinates listed in Table 3.1 are in accordance with the Y-12 master grid system (North and East coordinates measured in feet).

3.5 SCOPE OF THE SURVEY

The survey included:

- Gamma exposure rate measurements at 1 m above the ground surface and at the surface at accessible grid points.

- A surface gamma scan (Fig. 3.2) of accessible land areas [~53,000 m^2 (13 acres)], including Hot Yard Road. Surveyed grid blocks are shaded in Fig. 3.1. The NaI scintillation probe held approximately 5 cm (2 in.) above the ground surface was used to detect gamma radiation. The gamma scan of Hot Yard Road was conducted prior to the recent addition of gravel material (Fig. 3.3).

- Beta-gamma and alpha spot-check measurements of selected scrap material.

- Isotope dilution/mass spectrometry analysis and gamma spectrometry screening of selected samples.

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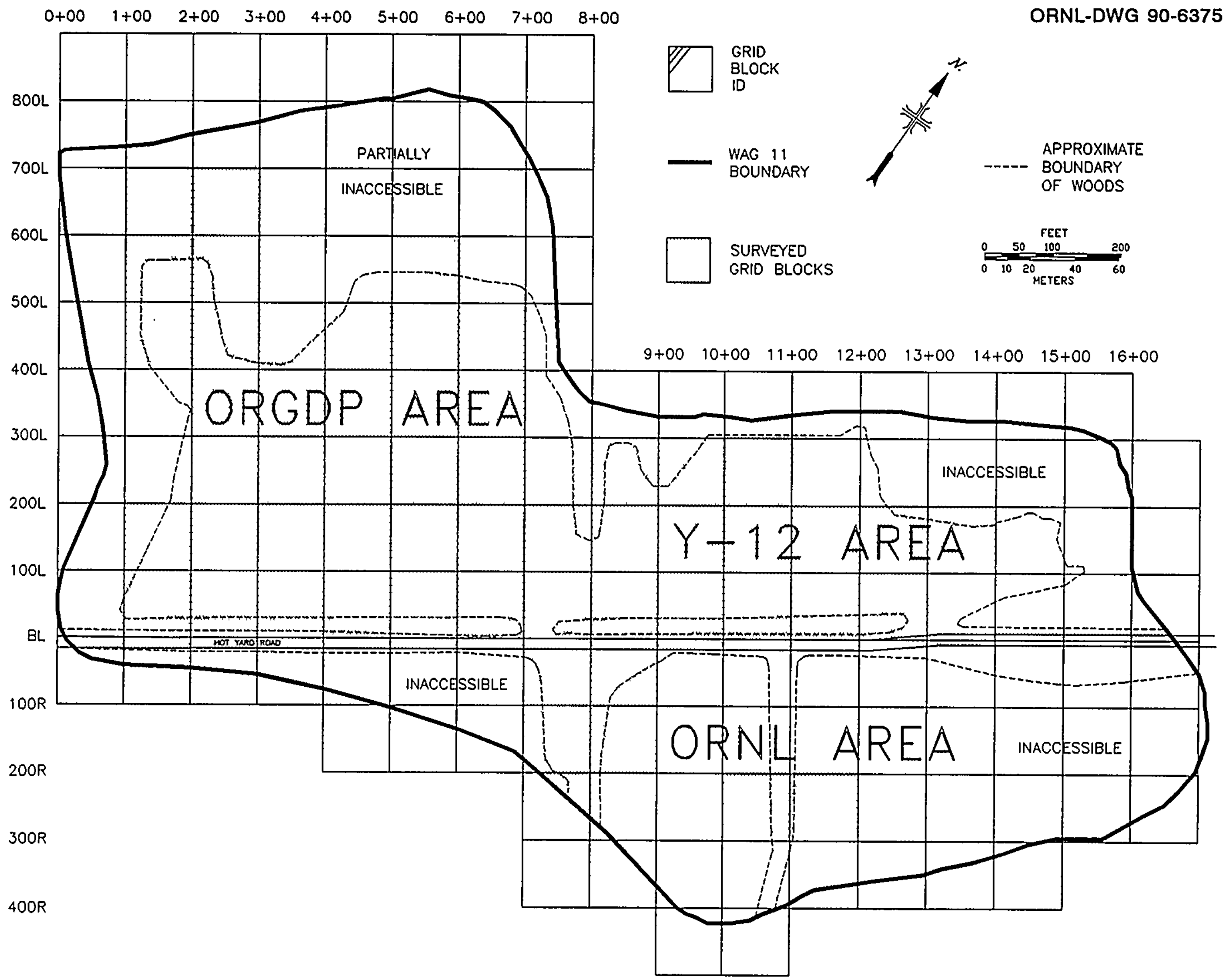

Fig. 3.1. Diagram showing grid block locations at the White Wing Scrap Yard site. Reportedly, the area north of Hot Yard Road was used by ORGDP and Y-12, and the area south of the road was used by ORNL. Accessible areas of the shaded grid blocks were surveyed.

Table 3.1. Gamma exposure rate measurements at selected grid points at the White Wing Scrap Yard site

Grid point[a]	Location[b] North	Location[b] East	Gamma exposure rate (μR/h) 1 m above ground surface	Gamma exposure rate (μR/h) Surface
0+00, BL	34,833.4977	27,665.9435	c	c
0+00, 100L	34,932.5410	27,652.1438	11	10
0+00, 200L	35,031.5842	27,638.3441	c	c
0+00, 300L	35,130.6275	27,624.5445	c	c
0+00, 400L	35,229.6708	27,610.7448	c	c
0+00, 500L	35,328.7140	27,596.9451	c	c
0+00, 600L	35,427.7573	27,583.1454	c	c
0+00, 700L	35,526.8006	27,569.3457	c	c
0+00, 800L	35,625.8439	27,555.5461	c	c
0+00, 900L	35,724.8871	27,541.7464	c	c
1+00, BL	34,847.2974	27,764.9868	c	c
1+00, 100L	34,946.3407	27,751.1871	12	10
1+00, 200L	35,045.3839	27,737.3874	13	15
1+00, 300L	35,144.4272	27,723.5878	c	c
1+00, 400L	35,243.4705	27,709.7881	c	c
1+00, 500L	35,342.5138	27,695.9884	13	10
1+00, 600L	35,441.5570	27,682.1887	11	11
1+00, 700L	35,540.6003	27,668.3890	19	19
1+00, 800L	35,639.6436	27,654.5894	c	c
1+00, 900L	35,738.6868	27,640.7897	c	c
1+00, 100R	34,798.2541	27,778.7865	c	c
2+00, BL	34,861.0971	27,864.0300	c	c
2+00, 100L	34,960.1404	27,850.2303	19	13
2+00, 200L	35,059.1836	27,836.4806	17	15
2+00, 300L	35,158.2269	27,882.6310	32	32
2+00, 400L	35,257.2702	27,808.8313	15	14
2+00, 500L	35,356.3135	27,795.0316	38	48
2+00, 600L	35,455.3567	27,781.2319	27	27
2+00, 700L	35,554.4000	27,767.4322	11	12
2+00, 800L	35,653.4433	27,753.6326	c	c
2+00, 900L	35,752.4865	27,739.8329	c	c
2+00, 100R	34,762.0538	27,877.8297	c	c

Table 3.1 (continued)

Grid point[a]	Location[b] North	Location[b] East	Gamma exposure rate (μR/h) 1 m above ground surface	Gamma exposure rate (μR/h) Surface
3+00, BL	34,874.8968	27,963.0733	c	c
3+00, 100L	34,973.9401	27,949.2736	42	46
3+00, 200L	35,072.9833	27,935.4739	32	30
3+00, 300L	35,172.0266	27,921.6743	19	23
3+00, 400L	35,271.0699	27,907.8746	15	15
3+00, 500L	35,370.1132	27,894.0749	23	27
3+00, 600L	35,469.1564	27,880.2752	c	c
3+00, 700L	35,568.1997	27,866.4755	c	c
3+00, 800L	35,667.2430	27,852.6759	c	c
3+00, 900L	35,766.2862	27,838.8762	c	c
3+00, 100R	34,775.8535	27,976.8730	c	c
4+00, BL	34,888.6965	28,062.1166	c	c
4+00, 100L	34,987.7398	28,048.3169	23	29
4+00, 200L	35,086.7830	28,034.5172	19	29
4+00, 300L	35,185.8263	28,020.7176	15	19
4+00, 400L	35,284.8696	28,006.9179	14	12
4+00, 500L	35,383.9129	27,993.1182	23	30
4+00, 600L	35,482.9561	27,979.3185	c	c
4+00, 700L	35,581.9994	27,965.5188	c	c
4+00, 800L	35,681.0427	27,951.7192	c	c
4+00, 900L	35,780.0859	27,937.9195	c	c
4+00, 100R	34,789.6532	28,075.9163	c	c
5+00, BL	34,902.4961	28,161.1599	c	c
5+00, 100L	35,001.5394	28,147.3602	17	19
5+00, 200L	35,100.5826	28,133.5605	17	19
5+00, 300L	35,199.6259	28,119.7609	25	29
5+00, 400L	35,298.6692	28,105.9612	c	c
5+00, 500L	35,397.7125	28,092.1615	c	c
5+00, 600L	35,496.7557	28,078.3618	19	19
5+00, 700L	35,595.7990	28,064.5621	c	c
5+00, 800L	35,694.8423	28,050.7625	c	c
5+00, 900L	35,793.8855	28,036.9628	c	c
5+00, 100R	34,803.4628	28,174.9596	c	c
5+00, 200R	34,704.4096	28,188.7593	c	c

Table 3.1 (continued)

Grid point[a]	Location[b]		Gamma exposure rate (μR/h)	
	North	East	1 m above ground surface	Surface
6+00, BL	34,916.2958	28,260.2031	c	c
6+00, 100L	35,015.3391	28,246.4034	34	23
6+00, 200L	35,114.3823	28,232.6037	23	19
6+00, 300L	35,213.4256	28,218.8041	13	11
6+00, 400L	35,312.4689	28,205.0044	30	38
6+00, 500L	35,411.5122	28,191.2047	34	38
6+00, 600L	35,510.5554	28,177.4050	c	c
6+00, 700L	35,609.5987	28,163.6053	c	c
6+00, 800L	35,708.6420	28,149.8057	c	c
6+00, 900L	35,807.6852	28,136.0060	c	c
6+00, 100R	34,817.2525	28,274.0028	c	c
6+00, 200R	34,718.2093	28,287.8025	c	c
7+00, BL	34,930.0955	28,359.2464	8	8
7+00, 100L	35,029.1388	28,345.4467	10	10
7+00, 200L	35,128.1820	28,331.6470	23	19
7+00, 300L	35,227.2253	28,317.8474	29	27
7+00, 400L	35,326.2686	28,304.0477	c	c
7+00, 500L	35,425.3119	28,290.2480	c	c
7+00, 600L	35,524.3551	28,276.4483	c	c
7+00, 700L	35,623.3984	28,262.6486	c	c
7+00, 800L	35,722.4417	28,248.8490	c	c
7+00, 900L	35,821.4849	28,235.0493	c	c
7+00, 100R	34,831.0522	28,373.0461	9	9
7+00, 200R	34,732.0090	28,386.8458	9	10
8+00, BL	34,943.8952	28,458.2897	9	8
8+00, 100L	35,042.9385	28,444.4900	11	12
8+00, 200L	35,141.9817	28,430.6903	13	13
8+00, 300L	35,241.0250	28,416.8907	11	10
8+00, 400L	35,340.0683	28,403.0910	c	c
8+00, 500L	35,439.1116	28,389.2913	c	c
8+00, 600L	35,538.1548	28,375.4916	c	c
8+00, 700L	35,637.1981	28,361.6919	c	c
8+00, 800L	35,736.2414	28,347.8923	c	c
8+00, 900L	35,835.2846	28,334.0926	c	c

Table 3.1 (continued)

Grid point[a]	Location[b] North	Location[b] East	Gamma exposure rate (μR/h) 1 m above ground surface	Gamma exposure rate (μR/h) Surface
8+00, 100R	34,844.8519	28,472.0894	10	10
8+00, 200R	34,745.8087	28,485.8891	c	c
8+00, 300R	34,646.7654	28,499.6887	c	c
9+00, BL	34,957.6948	28,557.3329	c	c
9+00, 100L	35,056.7381	28,543.5332	12	10
9+00, 200L	35,155.7813	28,529.7335	11	13
9+00, 300L	35,254.8246	28,515.9339	19	14
9+00, 400L	35,353.8679	28,502.1342	c	c
9+00, 500L	35,452.9112	28,488.3345	c	c
9+00, 100R	34,858.6515	28,571.1326	c	c
9+00, 200R	34,759.6083	28,584.9323	c	c
9+00, 300R	34,660.5650	28,598.7319	c	c
9+00, 400R	34,561.5217	28,612.5316	c	c
9+00, 500R	34,462.4785	28,626.3313	c	c
10+00, BL	34,971.4945	28,656.3762	c	c
10+00, 100L	35,070.5378	28,642.5765	10	11
10+00, 200L	35,169.5810	28,628.7768	13	12
10+00, 300L	35,268.6243	28,614.9772	11	10
10+00, 400L	35,367.6676	28,601.1775	c	c
10+00, 500L	35,466.7109	28,587.3778	c	c
10+00, 100R	34,872.4512	28,670.1759	c	c
10+00, 200R	34,773.4080	28,683.9756	10	10
10+00, 300R	34,674.3647	28,697.7752	c	c
10+00, 400R	34,575.3214	28,711.5749	c	c
10+00, 500R	34,476.2782	28,725.3746	c	c
11+00, BL	34,985.2942	28,755.4195	c	c
11+00, 100L	35,084.3375	28,741.6198	11	12
11+00, 200L	35,183.3807	28,777.8201	15	17
11+00, 300L	35,282.4240	28,714.0205	c	c
11+00, 400L	35,381.4673	28,700.2208	c	c
11+00, 500L	35,480.5106	28,686.4211	c	c

Table 3.1 (continued)

Grid point[a]	Location[b] North	Location[b] East	Gamma exposure rate (μR/h) 1 m above ground surface	Gamma exposure rate (μR/h) Surface
11+00, 100R	34,886.2509	28,769.2192	c	c
11+00, 200R	34,787.2077	28,783.0189	9	9
11+00, 300R	34,688.1644	28,796.8185	c	c
11+00, 400R	34,589.1211	28,810.6182	c	c
12+00, BL	34,999.0939	28,854.4621	c	c
12+00, 100L	35,098.1372	28,840.6630	11	11
12+00, 200L	35,197.1804	28,826.8633	9	10
12+00, 300L	35,296.2237	28,813.0637	c	c
12+00, 400L	35,395.2670	28,799.2640	c	c
12+00, 500L	35,494.3103	28,785.4643	c	c
12+00, 100R	34,900.0506	28,868.2624	c	c
12+00, 200R	34,801.0074	28,882.0621	c	c
12+00, 300R	34,701.9641	28,895.8617	c	c
12+00, 400R	34,602.9208	28,909.6614	c	c
13+00, BL	35,012.8936	28,953.5060	c	c
13+00, 100L	35,111.9369	28,939.7063	c	c
13+00, 200L	35,210.9801	28,925.9066	10	12
13+00, 300L	35,310.0234	28,912.1070	c	c
13+00, 400L	35,409.0667	28,898.3073	c	c
13+00, 500L	35,508.1100	28,884.5076	c	c
13+00, 100R	34,913.8503	28,967.3057	c	c
13+00, 200R	34,814.8071	28,981.1054	c	c
13+00, 300R	34,715.7638	28,994.9050	c	c
13+00, 400R	34,616.7205	29,008.7047	c	c
14+00, BL	35,026.6932	29,052.5493	c	c
14+00, 100L	35,125.7365	29,038.7496	c	c
14+00, 200L	35,224.7797	29,024.9499	c	c
14+00, 300L	35,323.8230	29,011.1503	c	c
14+00, 400L	35,422.8663	28,997.3506	c	c
14+00, 500L	35,521.9096	28,983.5509	c	c

Table 3.1 (continued)

Grid point[a]	Location[b] North	Location[b] East	Gamma exposure rate (μR/h) 1 m above ground surface	Gamma exposure rate (μR/h) Surface
14+00, 100R	34,927.6499	29,066.3490	c	c
14+00, 200R	34,828.6067	29,080.1487	c	c
14+00, 300R	34,729.5634	29,093.9483	c	c
14+00, 400R	34,630.5201	29,107.7480	c	c
15+00, BL	35,040.4929	29,151.5926	c	c
15+00, 100L	35,139.5362	29,137.7929	c	c
15+00, 200L	35,238.5794	29,123.9932	c	c
15+00, 300L	35,337.6227	29,110.1936	c	c
15+00, 400L	35,436.6660	29,096.3939	c	c
15+00, 100R	34,941.4496	29,165.3923	c	c
15+00, 200R	34,842.4064	29,179.1920	c	c
15+00, 300R	34,743.3631	29,192.9916	c	c
15+00, 400R	34,644.3198	29,206.7913	c	c
16+00, BL	35,054.2926	29,250.6358	c	c
16+00, 100L	35,153.3359	29,236.8361	c	c
16+00, 200L	35,252.3791	29,223.0364	c	c
16+00, 300L	35,351.4224	29,209.2368	c	c
16+00, 100R	34,955.2493	29,264.4355	c	c
16+00, 200R	34,856.2061	29,278.2357	c	c
16+00, 300R	34,757.1628	29,292.0348	c	c
17+00, BL	35,068.0922	29,349.6791	c	c
17+00, 100R	34,969.0489	29,363.4788	c	c
17+00, 200R	34,870.0057	29,377.2785	c	c

[a]Grid blocks are shown on Fig. 3.1.
[b]Y-12 grid coordinates measured in feet.
[c]Not measured.

ORNL-PHOTO 401-90

Fig. 3.2. Radiological survey team conducting a surface gamma scan at the White Wing Scrap Yard site (January 1990).

ORNL-PHOTO 385-90

Fig. 3.3. View looking east at Hot Yard Road at the White Wing Scrap Yard site (January 1990).

4. SURVEY RESULTS

4.1 BACKGROUND LEVELS

Background gamma exposure rates measured at uncontaminated outdoor areas on the Oak Ridge Reservation are listed in Table 4.1. Eighteen measurements taken at nine locations ranged from 8 to 13 μR/h (average 10 μR/h) at 1 m (3.3 ft) and from 10 to 17 μR/h (average 13 μR/h) at the surface.

Table 4.1. Radiation levels measured in uncontaminated areas on the Oak Ridge Reservation

	Radiation level (μR/h)	
Type of radiation[a]	Range	Average
Gamma exposure rate at 1 m above ground surface	8-13	10
Gamma exposure rate at ground surface	10-17	13

[a]Values were obtained from 18 measurements taken from nine locations on the Oak Ridge Reservation.

4.2 SURFACE GAMMA SCAN

Results of the surface gamma scan of accessible areas at the White Wing Scrap Yard site are shown in Figs. 4.1 and 4.2. In most areas, the hot spots (depicted by dots) are accurately located on Fig. 4.2, but in areas with numerous hot spots, the dots only approximate actual locations and numbers. Several acres of land were inaccessible to surface gamma scanning because of the overgrowth of trees and understory vegetation such as shrubs, weeds, and vines.

Numerous hot spots of elevated gamma exposure rates were identified over most of the accessible areas. In general, soil contamination was detected as small, localized spots throughout the site. There were several grid blocks in which large areas of residual soil contamination were detected. Typical surface radiation levels over the large field areas north and northeast of Hot Yard Road ranged from 10 to 40 μR/h, while south of the road radiation levels decreased to 8 to 30 μR/h (Fig. 4.1). Surface gamma measurements along Hot Yard Road (6 to 13 μR/h) indicate typical background radiation levels (Fig. 4.2).

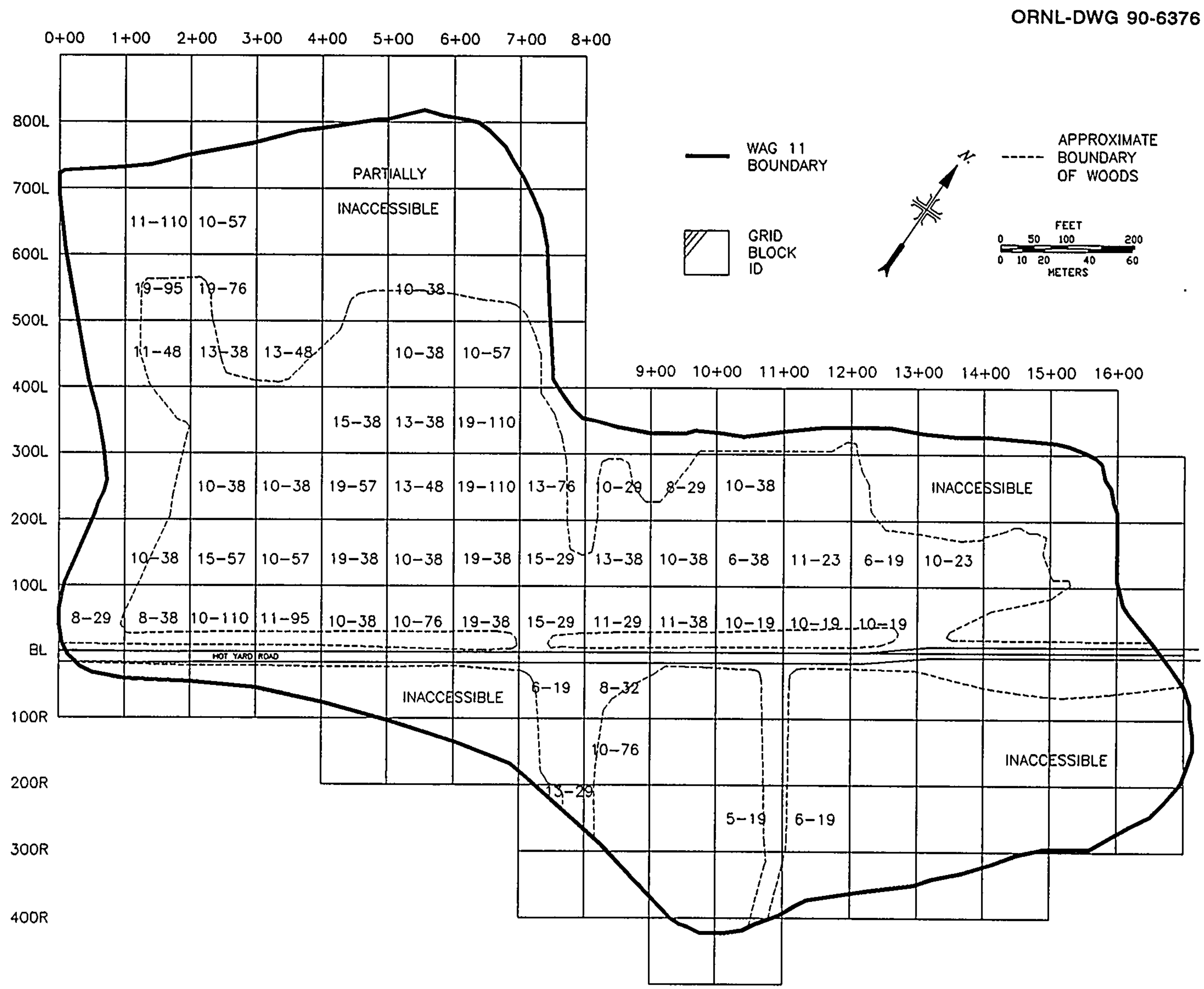

Fig. 4.1. Typical surface gamma exposure rates (μR/h) excluding hot spots in grid blocks at the White Wing Scrap Yard site. Measurements were taken only in accessible areas of the site.

Preliminary results show grid block location 1+00, 700L to be the most highly contaminated block north of Hot Yard Road. Three localized surface hot spots with gamma exposure rates of 12 mR/h, 6.2 mR/h, and 1.5 mR/h were found. Another highly contaminated grid block was located at 6+00, 400L where localized surface hot spots showed gamma exposure rates of 2.5 mR/h (6+75, 333L), 3.0 mR/h (6+66, 326L), and 0.8 mR/h (6+66, 303L).

4.3 BETA-GAMMA MEASUREMENTS

The highest beta-gamma activity level (85 mrad/h) was measured on the ground surface in an area encompassing <1 m^2 (Fig. 4.3) in grid block 1+00, 700L. Gamma spectrometry screening analysis of sample B12 from this area demonstrated the presence of ^{137}Cs.

A small, sealed gray metal box (Fig. 4.4) showing contact beta-gamma measurements of 9 mrad/h was found in grid block 1+00, 600L. "Determined to be Cadmium" was inscribed on the exterior of the box. After the box was carefully opened, interior measurements showed very low levels of radioactivity. Gamma spectrometry screening analysis of a smear sample collected from the exterior surface identified ^{238}U as the primary contaminant.

Beta-gamma spot-check measurements of selected debris on the ground surface included elevated levels up to 7.5 mrad/h on contact with the interior of an old metal air duct (Fig. 4.5) found north of Hot Yard Road (grid location 7+77, 237L). Beta-gamma activity levels reached 8 mrad/h on contact with the interior surface of 4 to 5 metal drums (aboveground at grid location 9+60, 320R) south of Hot Yard Road. The drums were empty and showed substantial corrosion.

4.4 SOIL/CONCRETE/ROCK/METAL SAMPLE ANALYSES

Results of analysis of soil/concrete/rock/metal samples show uranium as the dominant radiological contaminant. The locations of sampling sites are shown in Fig. 4.2. The results of isotopic dilution/mass spectrometry of four samples (B1A, B1B, B4, and B5) show elevated concentrations of uranium enriched in the isotope ^{235}U (see Table 4.2). The degree of enrichment was as high as 15 atomic percent ^{235}U in sample B4. The concentration of total uranium was 0.22 g of uranium per gram of analyzed sample (B4). It should be noted that samples B1A and B1B appeared to be a soil/concrete/rock mixture, whereas B4 and B5 samples consisted of a fused slag/rock/metal matrix.

Isotope dilution/mass spectrometry analysis results of sample B2 (green material) and sample B3 (yellowish-gray material) showed total uranium concentrations comprising ~40% and ~80% by weight, respectively, of the analyzed sample. X-ray diffraction spectra indicated that sample B2 was a probable mixture of uranium fluoride and uranium oxide compounds. Sample B3 was identified as uranyl hydroxide [$UO_2(OH)_2$]. Locations of sampling sites are depicted in Fig. 4.2. Field photographs of samples B2 and B3 are shown in Figs. 4.6 and 4.7, respectively.

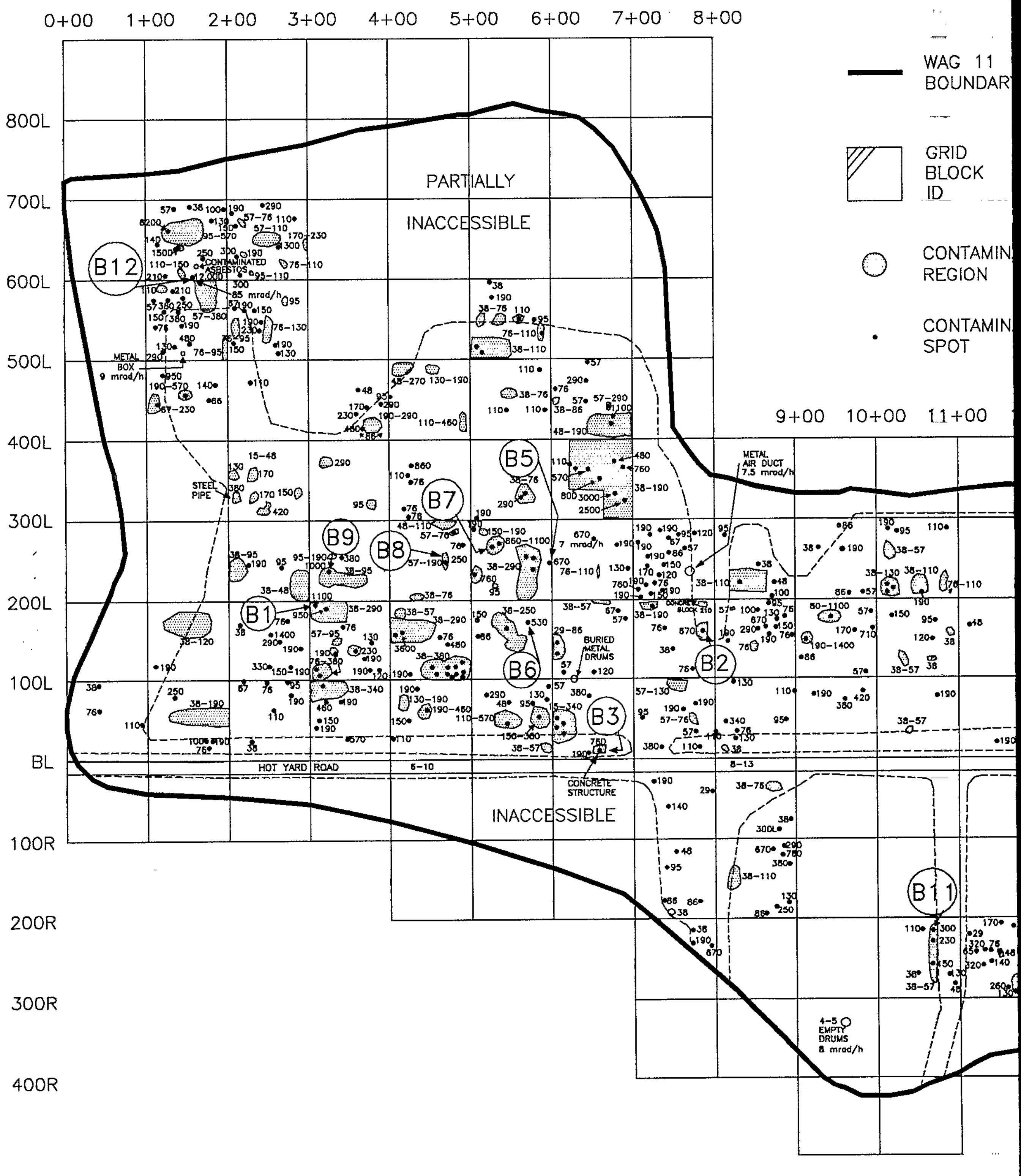

Fig. 4.2. Regions of elevated surface gamma exposure rates (μR/h) and sampling locations (site. Locations and numbers of contaminated hot spots are approximate. Measurements were taken only i areas were generally inaccessible.

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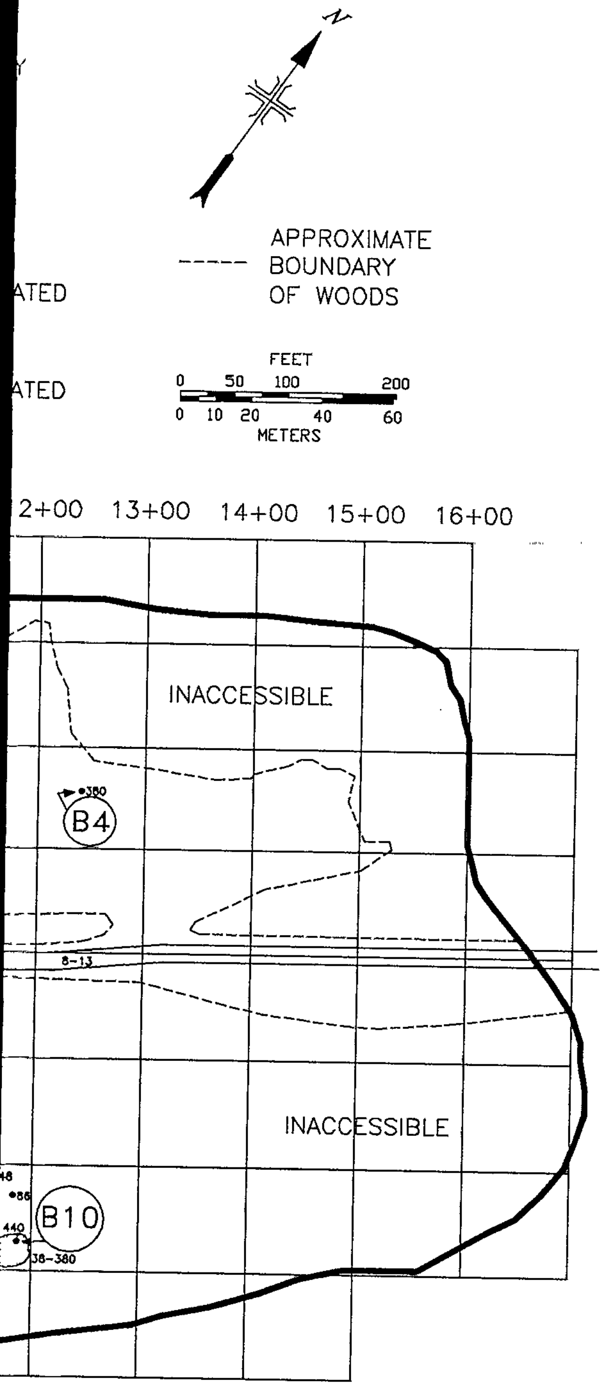

3#) at the White Wing Scrap Yard
a accessible areas of the site; wooded

K/PHOTO 90-1802

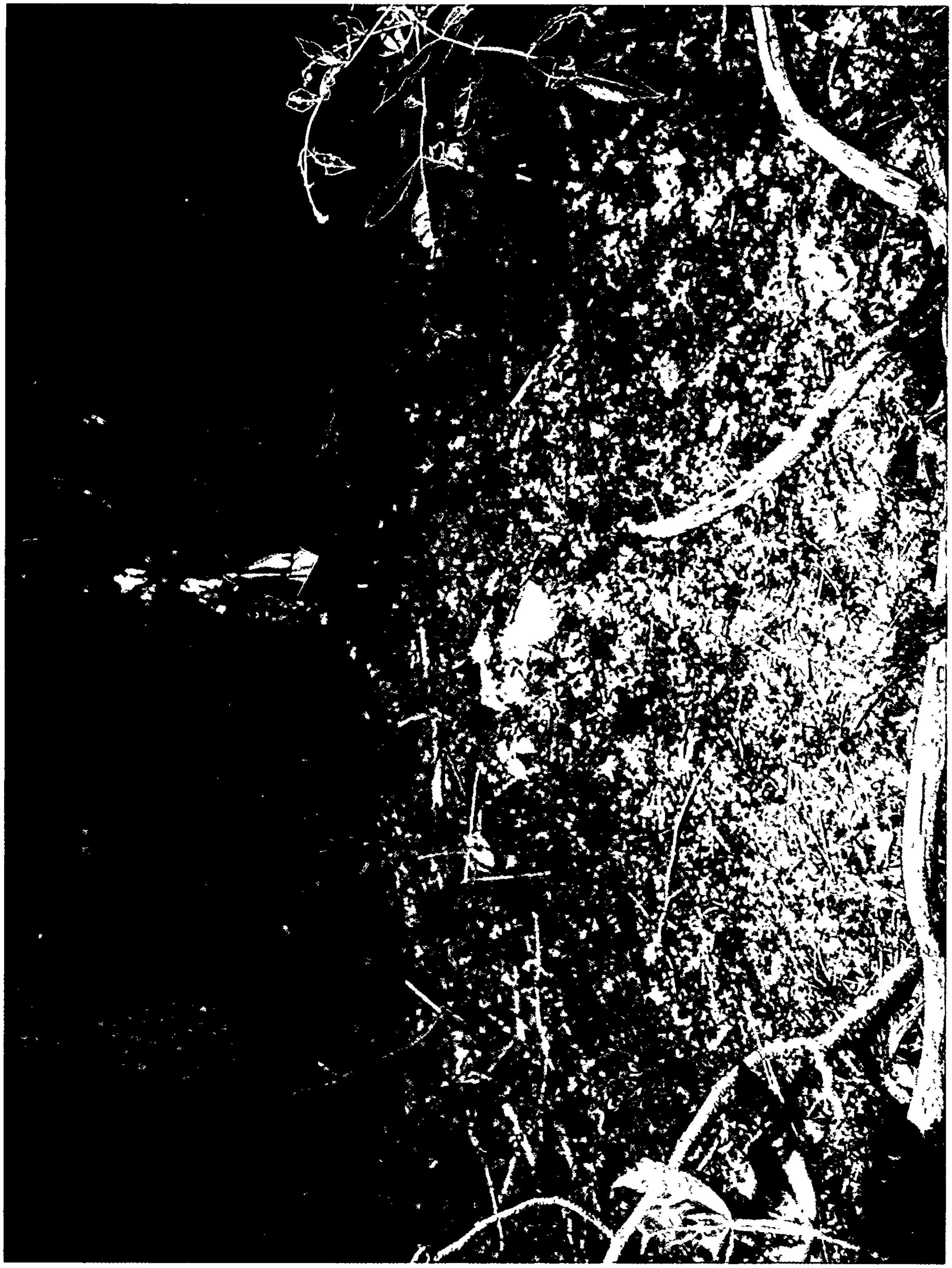

Fig. 4.3. Red flag indicating location of highest surface hot spot measurements (85 mrad/h; 12 mR/h) at the White Wing Scrap Yard site (June 1990).

K/PHOTO 90-1801

Fig. 4.4. Photograph of a contaminated metal box located in the ORGDP area of the White Wing Scrap Yard site (June 1990). A hammer is included for size comparison purposes only.

ORNL-PHOTO 393-90

Fig. 4.5. View of the contaminated metal air duct found north of Hot Yard Road at the White Wing Scrap Yard site (January 1990).

Table 4.2. Contribution of ^{234}U, ^{235}U, ^{236}U, and ^{238}U toward total uranium content in samples from the White Wing Scrap Yard site

Sample ID	Sample location[c]	Isotopic abundance (atomic percent)[a,b]			
		^{234}U	^{235}U	^{236}U	^{238}U
B1A	3+11, 200L	0.029 ± 0.001	4.669 ± 0.013	0.043 ± 0.001	95.259 ± 0.013
B1B	3+11, 200L	0.024 ± 0.001	4.570 ± 0.011	0.042 ± 0.001	95.364 ± 0.011
B2	7+79, 177L	0.0049 ± 0.0004	0.6766 ± 0.0038	0.0064 ± 0.0006	99.312 ± 0.004
B3	6+44, 20L	0.0040 ± 0.0004	0.6656 ± 0.003	0.0071 ± 0.0004	99.323 ± 0.0034
B4	12+40, 160L	0.15 ± 0.01	15.75 ± 0.15	*d*	84.10 ± 0.36
B5	5+95, 238L	0.022 ± 0.001	3.474 ± 0.009	0.029 ± 0.001	96.475 ± 0.010

[a]Isotopic dilution/mass spectrometry analysis performed by the Analytical Chemistry Division, ORNL.
[b]Analytical error of measurement is less than the 95% confidence level.
[c]Sample locations are shown on Fig. 4.2.
[d]No analysis conducted.

ORNL-PHOTO 1564-90

Fig. 4.6. View of the green uranium-contaminated material found on the ground surface north of Hot Yard Road at the White Wing Scrap Yard site (January 1990).

ORNL-PHOTO 1565-90

Fig. 4.7. View of the yellow uranium compound found on the top side of a large, concrete structure at the White Wing Scrap Yard site (January 1990).

Levels of the ^{235}U isotope in samples B2 (0.67 atomic percent) and B3 (0.66 atomic percent) indicate a slight depletion ($^{235}U < 0.7\%$) of this isotope compared with the natural relative abundance of uranium isotopes. Most likely, these samples are depleted by-products of uranium isotope separation (a step in the isotope enrichment process).

Five samples contained ^{236}U with isotopic abundances ranging from 0.0064% to 0.043%. The presence of the isotope ^{236}U indicates that the uranium contamination found on this site originated with reprocessed reactor fuel. The presence of plutonium has not been detected in any of the samples.

Gamma spectrometry screening analysis of samples B6A, B6B, B8A, B8B, B9, B10, and B11 indicate the presence of ^{238}U and ^{235}U. Cesium-137 was detected in samples B7A, B7B, and B12. Further analytical results of these samples will be provided in the addendum ORNL/ER/INT report at a latter date.

Preliminary analytical results of three soil samples collected from a region of dead vegetation at the former ORGDP scrapping operations area show elevated concentrations of polychlorinated biphenyls (PCBs). Each sample contained ~10 ppm total PCBs (the primary contributor being Aroclor 1254). The Environmental Protection Agency (EPA) method SW846 was followed in this analysis; subsequent organic/inorganic testing of samples is currently being conducted. The results of this test and precise sampling locations at the White Wing Scrap Yard site will be included in the addendum report.

5. SIGNIFICANCE OF FINDINGS

Surface measurements and visual observations at the White Wing Scrap Yard have identified a wide variety of radiological and physical hazards. Widespread clusters of small, localized radioactive hot spots were found throughout most of the accessible areas of the site. The most numerous and concentrated regions of contamination encompassing several grid blocks were identified north of Hot Yard Road. Preliminary results show grid block location 1+00, 700L to be the most highly contaminated block north of Hot Yard Road. Three localized surface hot spots with gamma exposure rates of 12 mR/h, 6.2 mR/h, and 1.5 mR/h were found. Highest ground-surface beta-gamma measurements (85 mrad/h) were recorded in the same grid block. Additional soil sampling at these hot spots with subsequent radiological and mixed-waste analyses will be conducted and the results presented in an addendum report. It should be noted that radiological data are limited for regions south of Hot Yard Road because of the large, inaccessible land areas and the time constraints of this cursory investigation. As previously discussed, wet surface conditions existed over the entire site during most of the survey period.

The presence of residual contamination in soil and radioactively contaminated debris on the ground surface and in the soil matrix demonstrates that previous cleanup operations (i.e., scrap removal) were insufficient (see Fig. 5.1). The extensive dispersion of contamination probably resulted from several past activities, including the storage of contaminated materials (e.g., metal, glass, concrete, and miscellaneous trash), removal of scrap materials, and preliminary cleanup activities. Although cleanup activities and remediation of localized areas of contaminated soil have reportedly occurred, these survey results show that current radiological conditions of the site remain an environmental problem and a potential risk to human health. It should be noted that, during the course of gamma scanning, no evidence of transferrable contamination was detected as survey personnel were screened for radioactive contamination prior to exiting the site; however, during the soil sampling process, transferrable beta-gamma contamination was detected on shoe covers.

Major findings of the survey include the following:

1. Highly radioactive, green-colored aggregate lumps of material (Fig. 4.6), located north of Hot Yard Road (grid 7+79, 177L), were found deposited in what appeared to be an old wood-framed air filter lying on the ground surface. Gamma exposure rate measurements on contact with a plastic bag containing a sample of this material showed levels of up to 2.5 mR/h; beta-gamma dose rates measured 7 mrad/h. Isotope dilution/mass spectrometry analysis results show uranium concentrations of ~40% by weight (probable composition, a mixture of uranium fluoride and uranium oxide compounds; sample B2).

2. On the top side of a large, oblong concrete structure immediately north and adjacent to Hot Yard Road (grid location 6+44, 20L), a coarse, yellowish-gray material was found to be highly radioactive (see Fig. 4.7). Gamma exposure rate measurements on

ORNL-PHOTO 1562-90

Fig. 5.1. View of gloves, shoes, and various debris on the ground surface at the White Wing Scrap Yard site (February 1990).

contact with a plastic bag containing a sample of this material showed levels of up to 5 mR/h; beta-gamma dose rates measured 15 mrad/h. Isotope dilution/mass spectrometry analysis results show uranium concentrations of ~80% by weight (composition, uranyl hydroxide; sample B3).

3. In a wooded area north of Hot Yard Road (grid location 6+14, 100L), a small (~1-m^2) area of surface subsidence [~1.5 m (5 ft) in depth] revealed portions of several buried, 0.2-m^3 (55-gal) metal drums (see Fig. 5.2). No significant levels of beta-gamma radiation were detected in the hole, although levels were slightly above background. At another remote area northeast of Hot Yard Road, an old transformer/capacitor device, partially covered with a dark, oily substance, was found on the ground surface (see Fig. 5.3). This may suggest possible PCB contamination and the potential for additional PCB-containing materials on the site. In addition, a sealed glass bottle containing an unidentified liquid (Fig. 5.4) was found in the ORNL area of the site. These findings further emphasize the need for a more thorough site assessment of possible hazardous waste contamination. The potential for subsurface soil and groundwater contamination from fugitive hazardous waste at the White Wing Scrap Yard site exists because of the types and large quantities of scrap debris that have been and continue to be subjected to erosion by wind and water. Subsurface drilling into these suspect areas with subsequent RCRA Extraction Procedure Toxicity Characteristic tests and radiological analysis of core samples should be considered.

4. Long narrow strips of apparent asbestos material were found on the ground surface and/or partially buried in soil matrix at several locations north of Hot Yard Road. Additionally, a 0.2-m^3 (55-gal) metal drum containing apparent asbestos material (Fig. 5.5) was found in the ORNL area, south of Hot Yard Road. Verification of asbestos and identification analysis for specific asbestos fibers by ORNL Industrial Hygiene personnel cannot be completed because these materials were radioactively contaminated.[10] Elevated beta-gamma activity levels were measured on contact with the plastic sample bag. There is a low probability of airborne asbestos hazards due to the solid texture of the asbestos material. Additionally, wet or moist conditions that existed during the course of the survey reduced the potential for hazardous levels of airborne asbestos.

5. South of Hot Yard Road, a partially submerged 0.2-m^3 (55-gal) metal drum was found in a creek (Fig. 5.6). In conjunction with the obvious creek pollution due to the presence of the drum, off-site dispersion of contamination should be considered a possibility pending a detailed radiological and hazardous waste analysis of the metal drum, drum contents, if any, and water sampled from the creek.

6. Isotope dilution/mass spectrometry analysis of samples B1A, B1B, B4, and B5 show uranium contamination with enriched levels of the ^{235}U isotope (see Table 4.2). Grid locations for these samples are 3+11, 200L (B1A and B1B), 12+40, 160L (B4), and 5+95, 238L (B5). Levels of up to 15 atomic percent ^{235}U contributed toward the total uranium content of sample B4.

ORNL-PHOTO 404-90

Fig. 5.2. View of ground-surface subsidence where buried metal drums were found at the White Wing Scrap Yard site (January 1990). Reportedly this region was used by ORGDP.

ORNL-PHOTO 386-90

Fig. 5.3. View of surface debris, including an old transformer/capacitor device, at the White Wing Scrap Yard site (January 1990).

ORNL-PHOTO 1560-90

Fig. 5.4. A sealed glass bottle containing an unidentified liquid found on the ground surface at the White Wing Scrap Yard site (February 1990).

ORNL-PHOTO 1558-90

Fig. 5.5. Metal drum containing apparent asbestos material that is radioactively contaminated at the White Wing Scrap Yard site (February 1990).

ORNL-PHOTO 1563-90

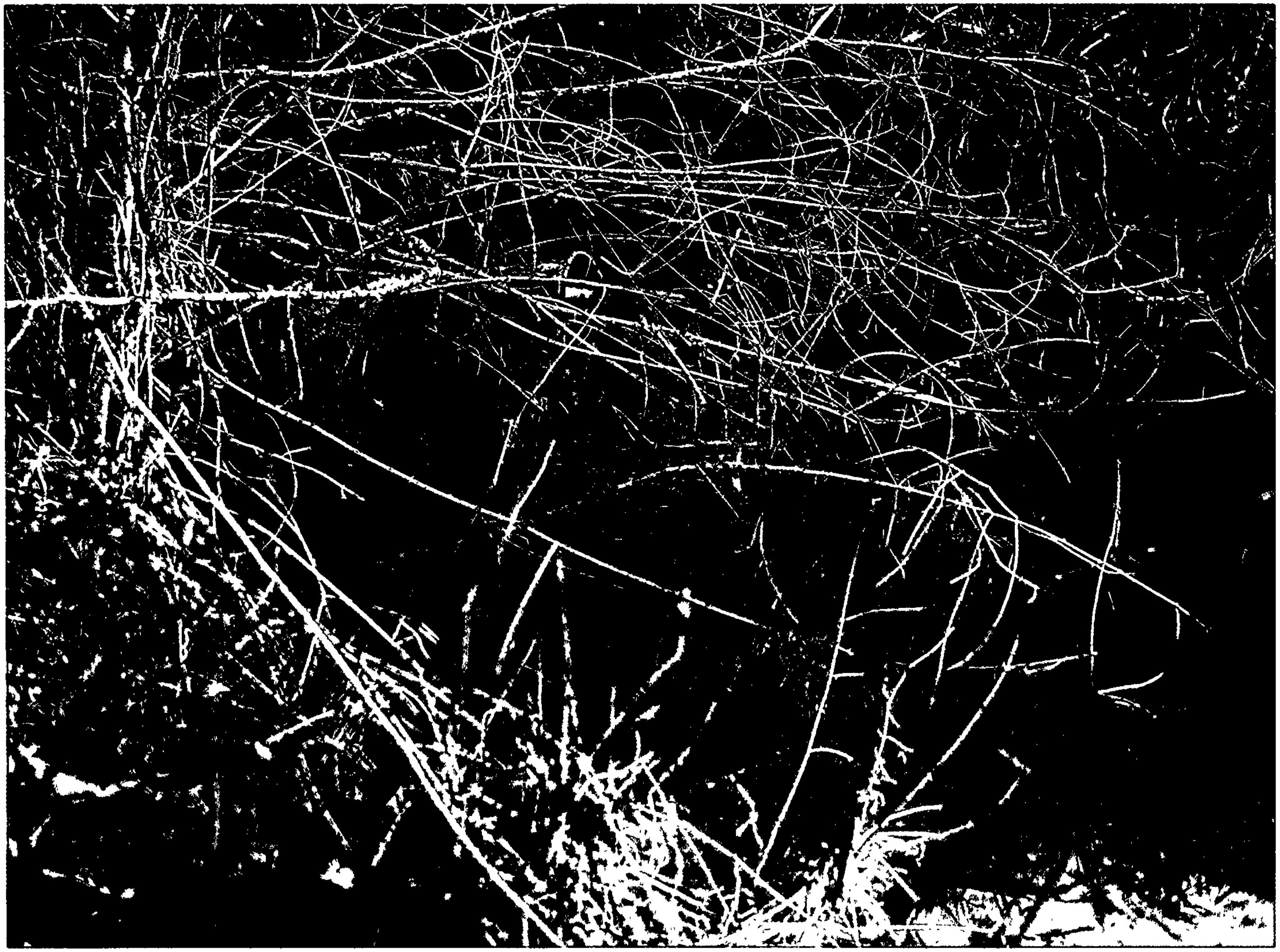

Fig. 5.6. View of a metal drum partially submerged in creek located south of Hot Yard Road at the White Wing Scrap Yard site (February 1990).

7. Elevated concentrations of PCBs (~10 ppm total PCBs) were identified in three soil samples collected from a region of dead vegetation found at the former ORGDP scrapping operations area (see Fig. 5.7). These preliminary results were immediately reported to the ORNL ERP and to Environmental, Health, and Safety Compliance personnel. Results of additional soil sample analyses will be provided in the addendum report.

Physical hazards on-site include hundreds of sharp pieces of metal and broken glass on the ground surface, primarily north of Hot Yard Road. In addition, surface vegetation, including several small trees, were reportedly poisoned from the toxic effect of residual acids and/or alkalies used in the decontamination of radioactive scrap material (see Fig. 5.7).

In general, the results of this cursory investigation show that most of the surface contamination is located north of Hot Yard Road. The presence and nature of uranium contamination (i.e., uranium enriched in the isotope ^{235}U) identified in samples collected from this area suggest that contaminated scrap material was stored by ORGDP and the Y-12 plant. Additional sampling with subsequent radiological analysis and radiation measurements of surface debris are necessary to fully characterize the site and accurately associate the waste types to responsible waste generators.

K/PHOTO 90-1800

Fig. 5.7. View of scattered debris in a region of dead vegetation located in the ORGDP area of the White Wing Scrap Yard site (June 1990).

6. RECOMMENDATIONS FOR CORRECTIVE ACTIONS

Highly elevated levels of gamma exposure rates, uranium contamination in soil, radioactively contaminated debris on the ground surface and in the soil matrix, and physical hazards throughout the surface of the site warrant immediate corrective actions. This conclusion is based exclusively on the results of this survey, which should be considered an interim evaluation pending detailed radiological and hazardous waste characterization of the site. The primary concern in considering corrective actions is the minimization of exposures of personnel to radiation. These recommendations are in accordance with the radiation safety policy of ORNL to conduct all operations in such a manner that personnel exposures to radiation or contamination are maintained at a level as low as reasonably achievable (ALARA).

Two basic approaches to interim corrective actions are (1) isolation of the entire White Wing Scrap Yard site (e.g., fencing), including measures to prevent dispersion of radioactivity, and (2) removal, treatment (if required), and disposal of contaminated soil, ground cover, and scrap debris, followed by stabilization of the treated areas. It should be noted that a 1967 aerial photograph of the scrap yard site (Fig. 2.3) shows apparent scrap material storage outside (east and south) of the existing WAG 11 boundary. On the basis of this information and the large number of inaccessible areas throughout the site, we recommend that an updated aerial radiological survey be conducted in conjunction with a magnatometer survey (for detection of metal). This type of survey would provide useful information in evaluating the current radiological status of the WAG 11 area.

Corrective action options listed below involve ground-surface measures to limit human exposures, minimize surficial dispersion of contamination, and monitor any such dispersion. Not every contamination situation would involve the implementation of all recommendations listed below; rather, the recommendations should be considered individually or in appropriate combinations. The radiological data presented in this report should be considered only a "snapshot" representation of the site. A more detailed investigation with core hole borings and soil analysis would be required to fully characterize the radiological status of the site and address the most appropriate methods for effective long-term remediation.

Isolation of contaminated areas

- Radiation control measures at the area boundary of the White Wing Scrap Yard are recommended. An upgrade or complete replacement of the old wire fence north and south of Hot Yard Road is needed. The fence should encompass areas north and south of Hot Yard Road with wire strands placarded with "Radiation Hazard—Keep Out" signs. Based on guidelines outlined in the ORNL Health Physics Procedure Manual, it is recommended that this type of sign be posted "in areas outside the main confines of the Laboratory and where members of the general public should be warned."[11] Access to the area north of Hot Yard Road should be restricted and the number of zone portals (point of entrance and exit) limited. A diagram of the scrap yard site, showing surface radiation levels and including instructions to contact the Maintenance and Surveillance Group of the ORNL ERP, should be posted at the west Hot Yard Road entrance into the scrap yard site. Additionally, the outdated sign presently posted at the west Hot Yard Road entrance should be upgraded to include a currently operational telephone number for responsible site personnel (Fig. 6.1).

- In conjunction with radiation control measures at the area boundary of the scrap yard site, isolation by fencing of contaminated regions and ground-surface hot-spot clusters (particularly north of Hot Yard Road) should be considered. Warning signs should be posted with instructions to contact the Radiation Protection Section of the Environmental and Health Protection Division before entering contaminated areas.

- Currently, the scrap yard site can be accessed via several entrances. The presence of contaminated soil and debris (found primarily north of Hot Yard Road) warrants stringent entrance requirements (e.g., metal gates). Because this area is accessed only for maintenance and monitoring activities, a controlled "exclusion area" should be considered until a decision is made on effective remedial actions.

- If remedial or cleanup actions are not implemented at this site, active and passive institutional control measures should be maintained for a specified period of time to allow for radioactive decay of intermediate-lived fission waste products such as ^{90}Sr and ^{137}Cs. Long-term institutional control (~300 years) would result in a 99% reduction of ^{90}Sr and ^{137}Cs activities (~10 half-lives). Periodic monitoring of radioactivity in soil, vegetation, surface water, and groundwater should be performed.

- High concentrations of uranium, uranium isotopes, and uranium compounds measured in soil/rock samples from the site indicate that a potential long-term problem exists (the half-life of ^{238}U is 4.5×10^9 years). It is therefore recommended that identified uranium contamination in soil be remediated because long-term institutional control measures are impractical and unrealistic.

- Radiation protection measures (e.g., personal radiation monitoring devices) should be considered for personnel not affiliated with Martin Marietta Energy Systems, Inc., who are involved with activities at the scrap yard area. At the identified regions of soil contamination, all activities that may potentially disturb and/or disperse radioactivity should cease if personnel involved with these operations (e.g., grass mowing) are not protected with appropriate radiation protection equipment. Personal respirators would minimize the potential for inhalation of radioactively contaminated soil/dust particles.

- Stabilization procedures (e.g., earthen caps, hydrologic isolation, and limited in situ grouting or vitrification) should be considered at radioactively contaminated soil areas where short- or intermediate-lived waste products have been identified.

ORNL-PHOTO 272-90

Fig. 6.1. View looking east at restricted entrance into White Wing Scrap Yard site from Hot Yard Road (January 1990).

- External radiation levels could be reduced at contaminated areas by covering contaminated ground-surface areas with clean, uncontaminated soil. However, if eventual remedial action requires removal of contaminated soil, the added cover would increase the volume of waste to be disposed of.

Removal, treatment, and disposal of contaminated material

- Highly contaminated soil hot spots/areas and debris materials should be remediated and disposed of in a designated radioactive waste disposal site. Excavation and removal of the contaminated soil must be carried out in full compliance with guidelines stated in the *Health, Safety, and Environmental Protection Procedures for Excavating Operations* manual.[12] It is essential that ORNL Health Physics personnel be present to monitor all activities associated with any disturbance of soil at the White Wing Scrap Yard site.

Verification of drum contents and drum removal

- Isolation procedures (i.e., roping) should be considered at the area of surface subsidence prior to mixed-waste analysis and subsequent verification of drum contents. Detailed subsurface characterization of this immediate area is recommended prior to drum removal. Additionally, radioactively contaminated metal drums found on the ground surface should be removed and disposed of in a designated radioactive waste disposal site.

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